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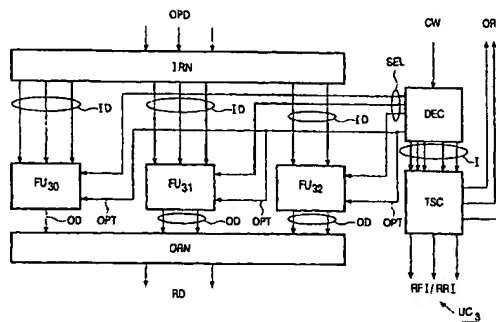
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(54) Title: APPARATUS, METHOD, AND COMPILER ENABLING PROCESSING OF VARIABLE LENGTH INSTRUCTIONS IN A VERY LONG INSTRUCTION WORD PROCESSOR



(57) Abstract: Computer architectures consist of a fixed data path, which is controlled by a set of control words. Each control word controls part of the data path. Each set of instructions generates a new set of control words. In case of a VLIW processor, multiple instructions are packaged into one so-called VLIW instruction. A VLIW processor uses multiple, independent functional units to execute these multiple instructions in parallel. Application specific domain tuning of a VLIW processor requires that instructions having varying requirements with respect to the number of instruction bits they require can be encoded in a single VLIW instruction, such that an efficient encoding and encoding of instructions is maintained. The present invention describes a processing apparatus as well as a processing method for processing data, allowing the use of such an asymmetric instruction set. The processing apparatus comprises at least a first (UC<sub>0</sub>) and a second issue slot (UC<sub>3</sub>), wherein each issue slot comprises a plurality of functional units (FU<sub>01</sub> - FU<sub>02</sub>, FU<sub>30</sub> - FU<sub>32</sub>). The first issue slot (UC<sub>0</sub>) is being controlled by a first control word (411) being generated from a first instruction (InstrA) and the second issue slot is being controlled by a second control word (417) being generated from the second instruction (InstrD), the width of the first control word (411) being different from the width of the second control word (417). By varying the width of a corresponding control word, instructions requiring a different number of bits can be efficiently encoded in a VLIW instruction while allowing an efficient instruction decoding as well.



TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)

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# INTERNATIONAL SEARCH REPORT

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## A. CLASSIFICATION OF SUBJECT MATTER

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According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 886 210 A (MATSUSHITA ELECTRIC IND CO LTD) 23 December 1998 (1998-12-23)	1,2,5,6, 8,9, 12-14
Y	page 4, line 27 - line 44	3,4,10, 11
Y	WO 98/27486 A (HEWLETT PACKARD CO) 25 June 1998 (1998-06-25) page 6, line 16 -page 8, line 21	3,4,10, 11
X	US 6 023 756 A (OKAMURA ATSUSHI) 8 February 2000 (2000-02-08) column 1, line 31 - line 51; figure 1	1,2,5,6, 8,9

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☒ Patent family members are listed in annex.

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Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 0886210	A	23-12-1998	JP 11007387 A	12-01-1999
			CN 1208197 A	17-02-1999
			EP 0886210 A2	23-12-1998
			IL 124904 A	25-07-2002
			SG 91248 A1	17-09-2002
			TW 490636 B	11-06-2002
			US 6085306 A	04-07-2000
			US 2002129223 A1	12-09-2002
			US 2002144084 A1	03-10-2002
			US 6397319 B1	28-05-2002
WO 9827486	A	25-06-1998	US 5870576 A	09-02-1999
			WO 9827486 A1	25-06-1998
			US 5930508 A	27-07-1999
US 6023756	A	08-02-2000	JP 2806359 B2	30-09-1998
			JP 9292991 A	11-11-1997